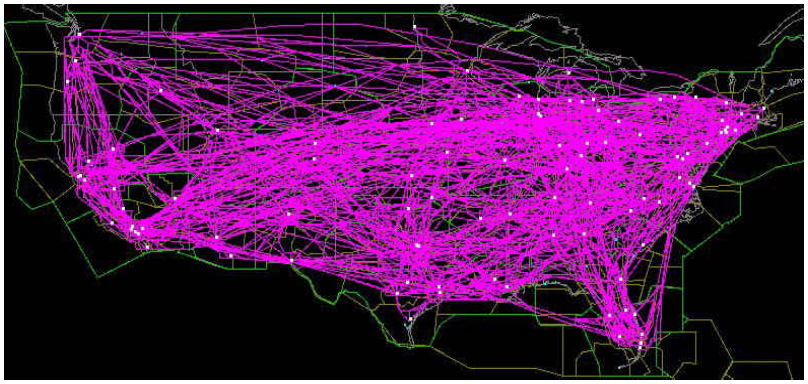
Preliminary Assessment of VAMS Concepts

May 17, 2002



May 12, 2022

Simulated Current and Future Traffic Demand using the Airspace Concept Evaluation System (ACES)

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Assessment Goal and Objectives

- Provide a preliminary, high-level assessment of the system-wide impacts on the NAS of two or more VAMS concepts using the VAMS Non-Real Time Tool, ACES
- Goals
  - Demonstrate unique ACES capabilities
  - Demonstrate concept effectiveness
- Constraints
  - Assessment package to be completed by Aug 4, 2003
  - Utilize the capabilities of an available ACES build
  - Limited personnel and equipment availability
  - Only rough estimates for concept benefits were available

An assessment of ACES' utility in assessing NAS concepts.

Note: the concept assessments produced are strictly notional.

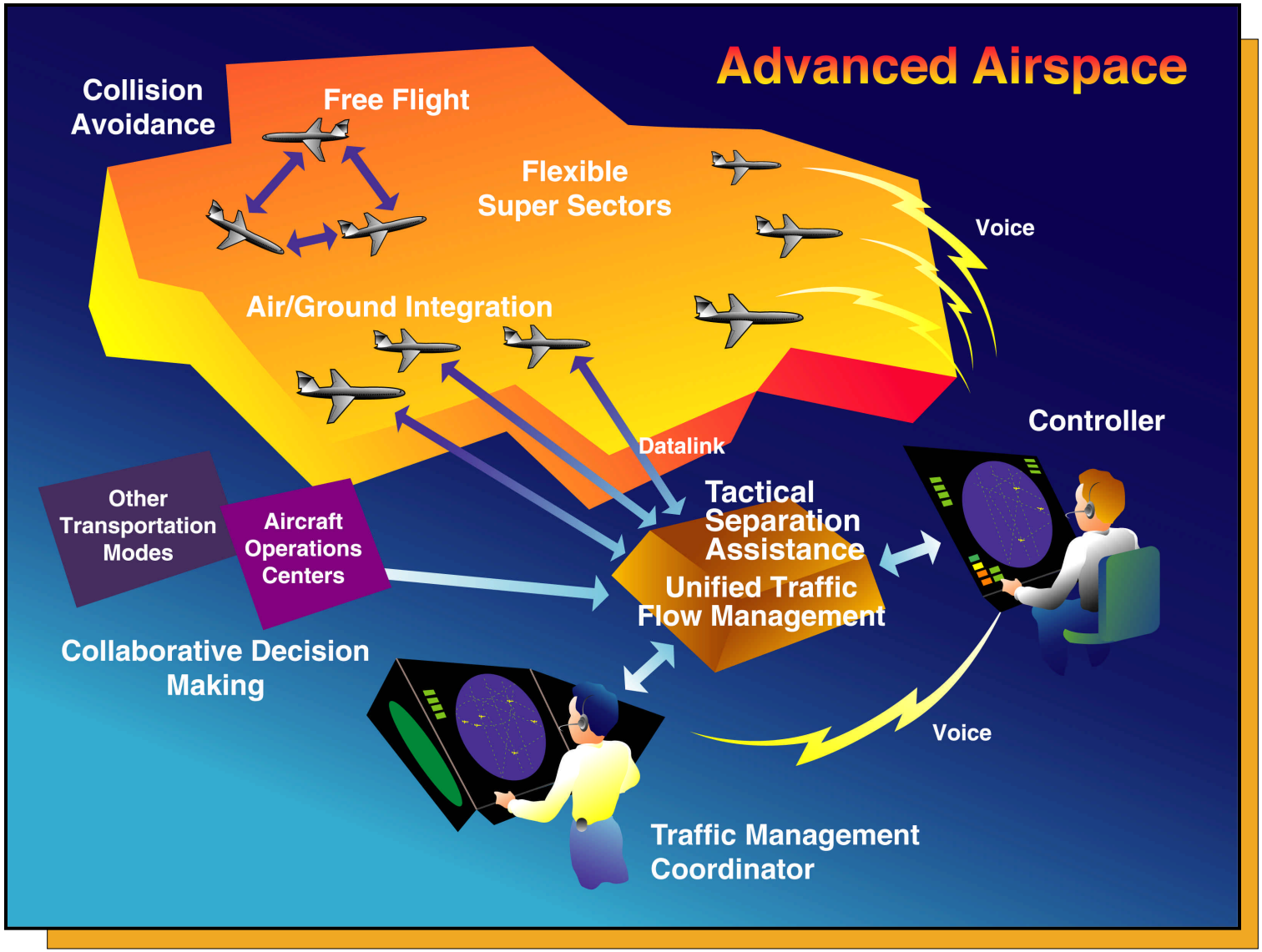
Assessment Approach

- Determine concepts to be analyzed given the state of concept definition and current abilities of ACES
- Define and generate Demand forecast
  - May 17, 2002
  - May 12, 2022
- Define test matrix and NAS configurations
- Define dependent / independent variables and data collection needs.
- Perform a comparative analysis across selected concepts for aircraft delay, sector overload, and total number of flights.

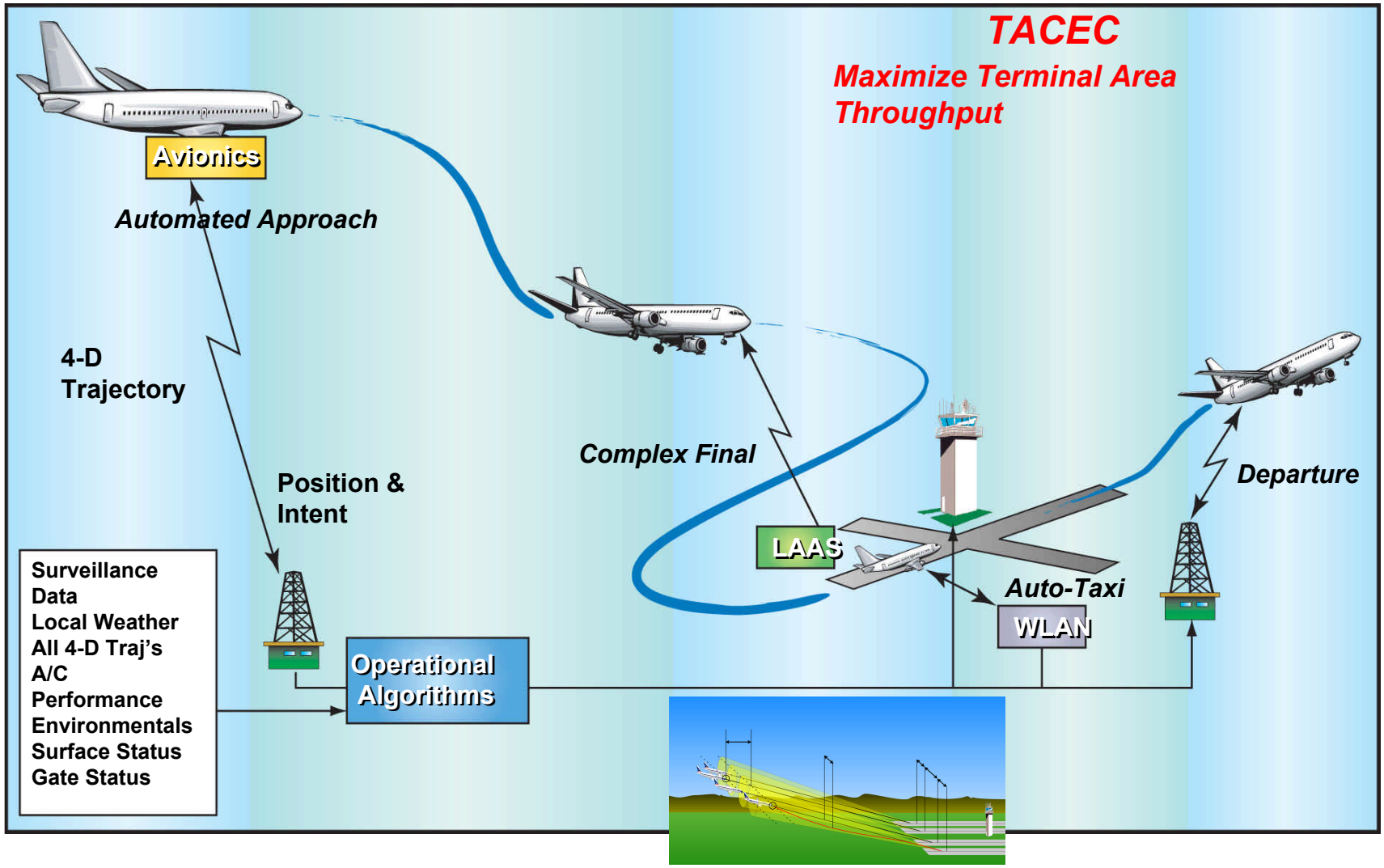
Assessment Choices

- Time constraint allowed 8 scenarios maximum.
- Use ACES Build 1.2
- One En-route Concept
  - Advanced Airspace Concept (AAC)
- Two Terminal Area Concepts
  - The Terminal Area Capacity Enhancement Concept (TACEC)
  - The Wake Vortex Avoidance Solution (WakeVAS)

Advanced Airspace Concept (AAC)



Terminal Area Capacity Enhancement Concept (TACEC)



Wake Vortex Avoidance Solution Concept (WakeVAS)

Aircraft Meteorological & State Data

Aircraft/Ground Data Link

NWS Data

- Sensor Data Fusing Algorithm
- Wake Prediction Algorithm
- Terminal Weather Predictor

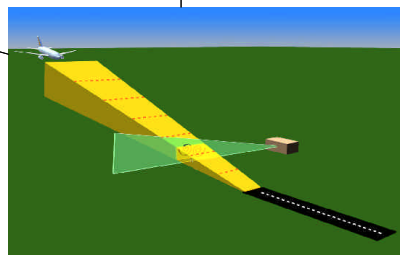
- Wake Hazard Computations
- Safety Monitor

Flight Deck Display/ Nav/Guidance Interface

Aircraft/Ground Data Link

Airport Wake and Weather Sensor Suite

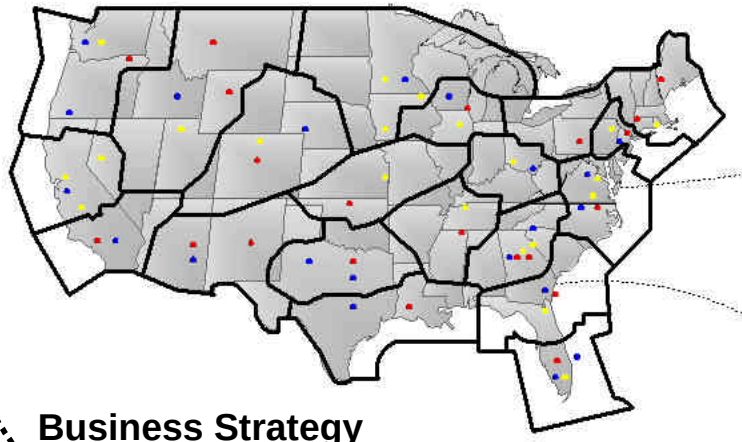
Protected Airspace Definition



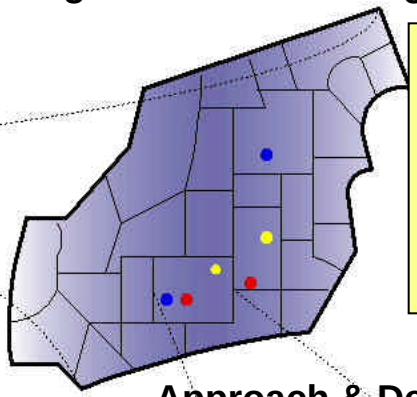
Controller Tool

ACES: Architecture, Infrastructure and Models

Strategic Traffic Management



Regional Traffic Management

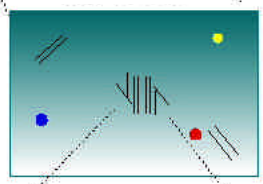


Agents	
Strategic	1
Regional	20
Approach/Depart	10s
Surface	100s
Aircraft	10,000s
Business Strategy	10s

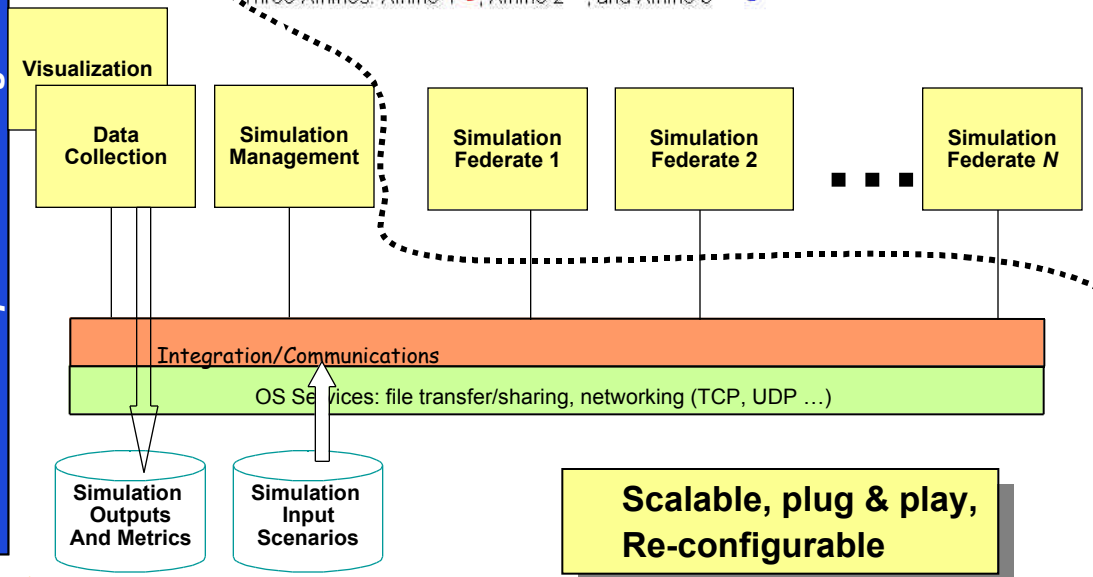
Business Strategy

Three Airlines: Airline 1 ●, Airline 2 ●, and Airline 3 ●

Approach & Departure Traffic Management



Surface Traffic Management



Scalable, plug & play, Re-configurable

Model Descriptions
ACES Build 1.2

TRACON
- Generic arrival & departure fixes

Airport TFM
- Projects takeoff & landing demand
- Impose TFM restrictions in TRACON

Airport ATC
- Simple/generic airports & terminals
- Manage runway queuing
- Gate arrival & departure times

TRACON TFM
- Impose airport & center TFM restrictions
- Assign planned takeoff times

TRACON ATC
- Set TRACON delay
- Assign departure fix crossing time (per aircraft separation rules)

ARTCC TFM
- Impose TFM restrictions Intra- and Inter- center TRACON
- Schedules as much delay as possible, passes on remaining delay

ARTCC ATC
- Meet TFM restrictions (speed/vector advisories)

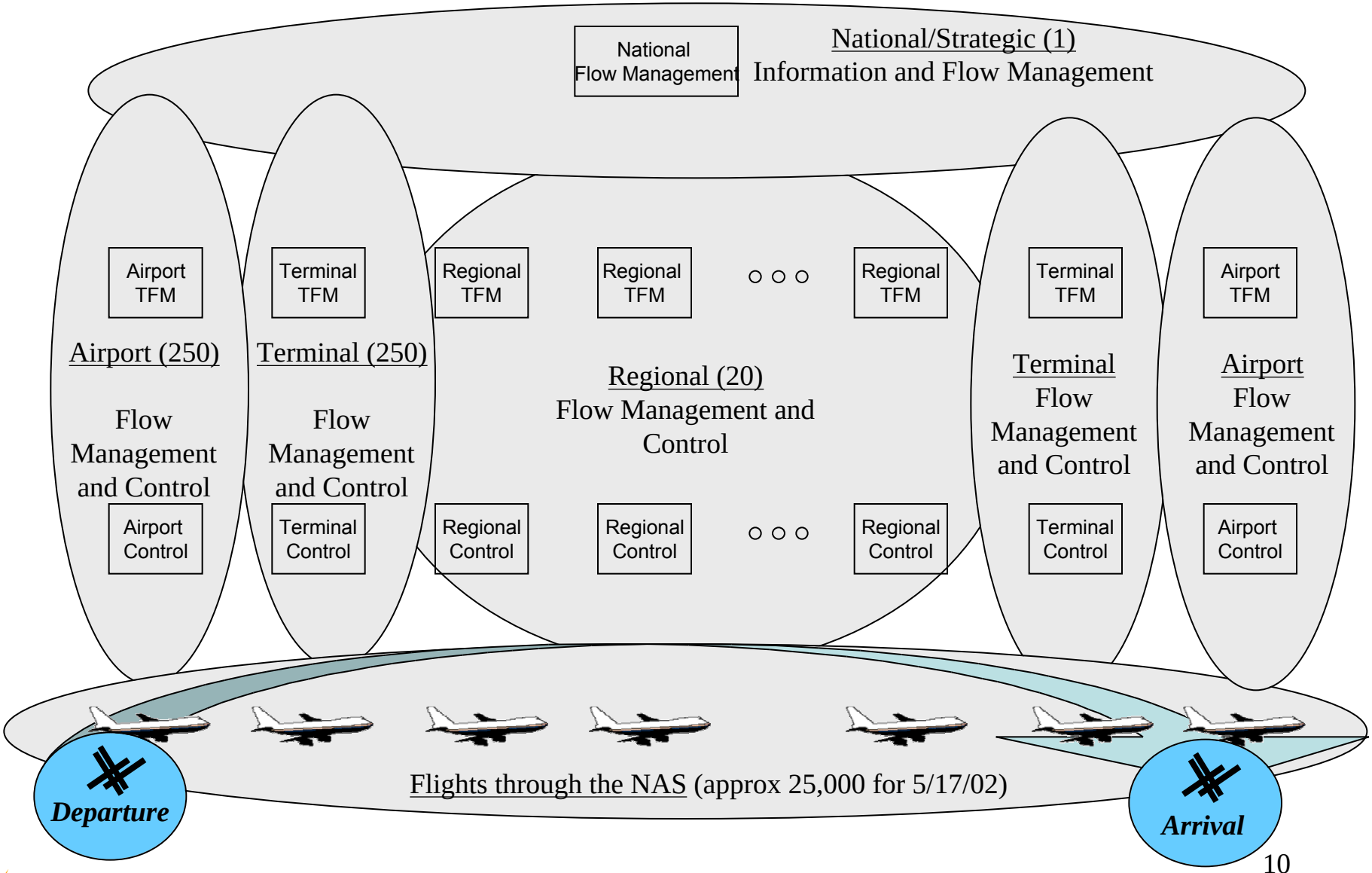
ATCSCC TFM
- Receives and transmits traffic information

Flight
- Trajectory propagation
- Pilot model

Wind
- 4D Winds

AOC
- Generate traffic demand

Summary of ACES Build 1 Agents



Demand Forecast Characteristics

NAS System Characteristics	Current NAS May 17, 2002 Demand	Future NAS May 12, 2022 Demand
Description	The demand schedule is real NAS data including winds (ETMS/RUC) and is post 9/11 at a period when demand was high and the aviation system was losing carriers in a highly competitive market	High GDP growth, coupled with many limits to aviation system growth and poor substitutes for commercial services, imply that airlines will be able to raise fares (yields). This scenario, although not the one with the highest level of traffic growth, is perhaps the most favorable for the major network carriers. Tracks GDP growth closely, historically excluding Gulf wars I and II Further growth in hub and spoke system Growth by low-cost carriers and others serving low yield sectors at secondary airports On-demand modes do not improve relative to scheduled service (Assumed OEP improvements)
NAS Environmental Factors	No significant en route weather No major Ground Holds or Ground Stops	No significant en route weather No major Ground Holds or Ground Stops
NAS Demand	High traffic day	High traffic day

Core Assessment Scenarios

Scenario Definition			Assessment Goal
Demand Schedule	Airport Capacity	En-route Capacity	
Current	Current All VFR	Unlimited	Reference
Current	Current VFR & IFR		Reference
Future	OEP All VFR		Reference
Future	OEP All VFR + WakeVAS		WakeVAS Evaluation
Future	OEP VFR & IFR		Reference
Future	OEP VFR & IFR + TACEC		TACEC Evaluation

Airport Capacity Definitions

Airport Capacity	Description
Current All VFR	VFR arrival and departure rates for all airports.
Current VFR & IFR	IFR arrival and departure rates for Benchmark 2001 airports. VFR rates for all other airports.
OEP All VFR	VFR arrival and departure rates for all airports. Rates for FAA Benchmark 2001 airports based on all OEP enhancements.
OEP VFR & IFR	IFR arrival and departure rates for Benchmark 2001 airports based on all OEP enhancements. VFR rates for all other airports.
OEP All VFR + WakeVAS	VFR arrival and departure rates for all airports. Rates for FAA Benchmark 2001 airports based on all OEP enhancements plus estimates WakeVAS benefits.
OEP VFR & IFR + TACEC	IFR arrival and departure rates for Benchmark 2001 airports based on all OEP enhancements plus estimated TACEC benefits. VFR rates for all other airports.

Benchmark 30 Airports

The Benchmark 31 Airports without HNL

ATL	-	Hartsfield Atlanta Intl
BOS	-	Logan International
BWI	-	Baltimore/Washington Intl
CLT	-	Charlotte Douglas Intl
CVG	-	Cincinnati/ Northern Kentucky Intl
DCA	-	Washington National
DEN	-	Denver International
DFW	-	Dallas/Ft Worth Intl
DTW	-	Detroit Metro Wayne County
EWR	-	Newark Liberty International
IAD	-	Dulles International
IAH	-	Houston Intercontinental
JFK	-	Kennedy International
LAS	-	Mc Carran International
LAX	-	Los Angeles International
LGA	-	La Guardia
MCO	-	Orlando International
MEM	-	Memphis International
MIA	-	Miami International
MSP	-	Minneapolis St Paul Intl
ORD	-	O'Hare
PHL	-	Philadelphia International
PHX	-	Phoenix Sky Harbor Intl
PIT	-	Pittsburgh International
SAN	-	San Diego Intl Lindbergh Fld
SEA	-	Seattle/Tacoma Intl.
SFO	-	San Francisco International
SLC	-	Salt Lake International
STL	-	Lambert St Louis Intl
TPA	-	Tampa International

Assessment Metrics

Capacity

- ***Total system metrics:***
  - Total Commercial Passenger Flights Flown per Day
  - Total Passenger Trips per Day
  - Total Revenue Passenger Miles Flown per Day
  - Total Aircraft Travel Time
- ***Airport level metrics:***
  - Flight Arrivals per Hour per Airport
  - Flight Departures per Hour per Airport
  - Passenger Arrivals per Hour per Airport
  - Passenger Departures per Hour per Airport

Throughput

- Peak Airport Throughput
- Peak En-route Throughput
- Sector Loading
- Number of Overloaded Sectors

Assessment Metrics (Cont.)

Efficiency

- Total Flight Travel Time
- Total Flight Miles Flown

Predictability

- Flights more than 15 minutes late from Scheduled Arrival Time
- Passengers more than 15 minutes late from Scheduled Arrival Time
- Average Minutes Late per Flight

Cost and Environment

- Total fuel burned

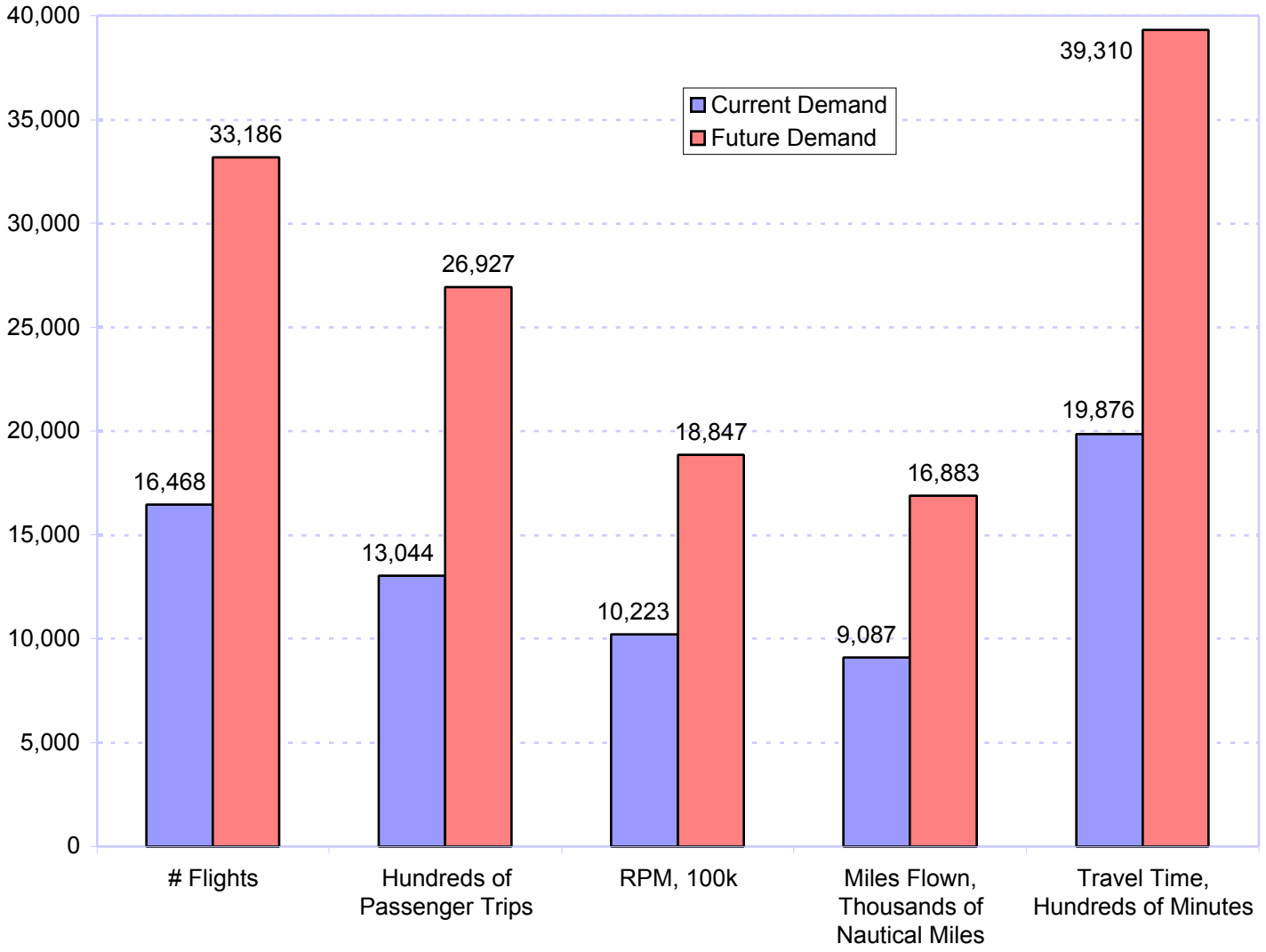
AAC Assessment

- No Sector Capacity Restrictions.
  Therefore, sector counts rise to the level needed to satisfy demand as allowed by available airport throughput.

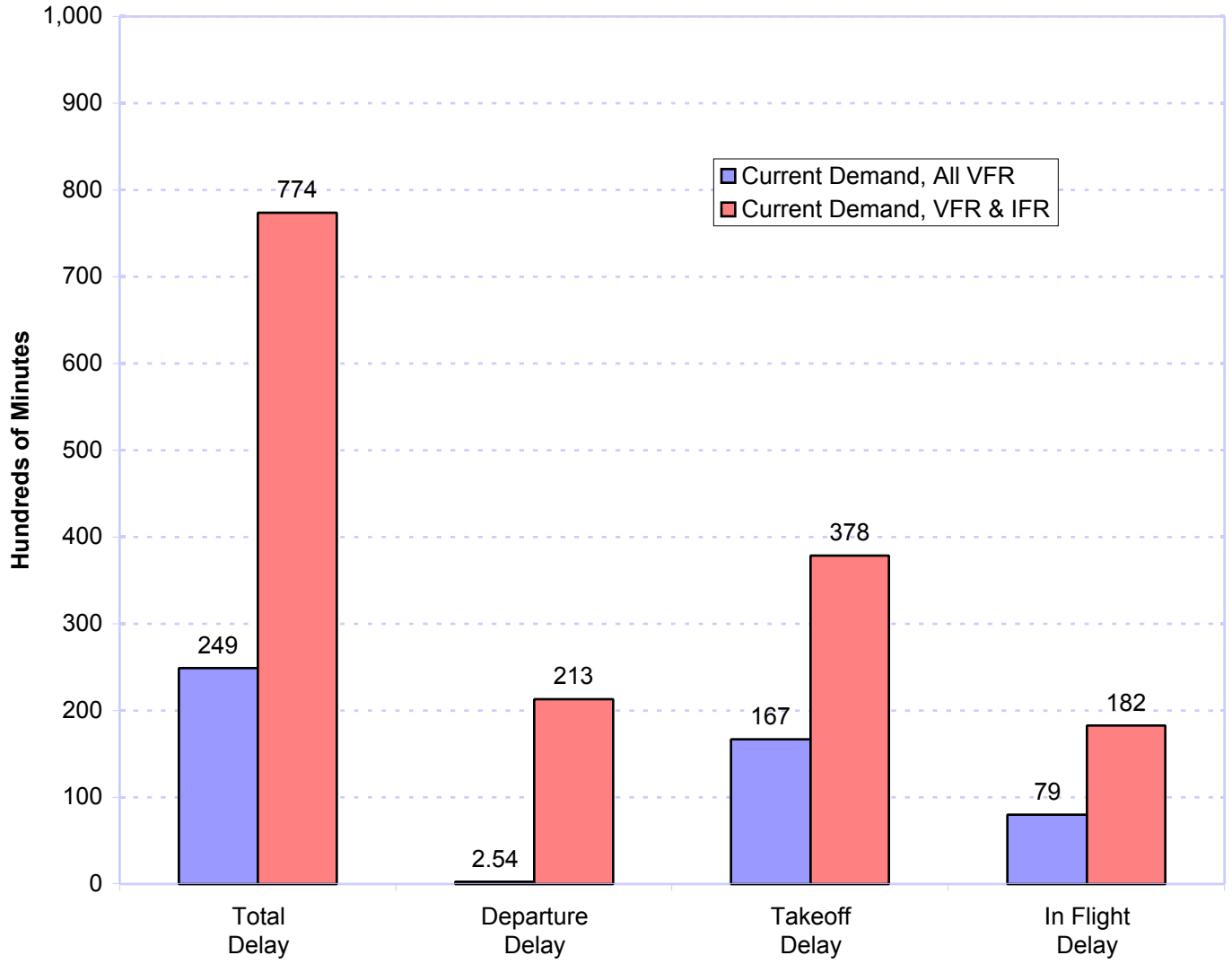
- AAC assessments are based on changes in the **need** for sector capacity due to changes in demand and airport throughput.

- The assessments results presented do not reflect sector capacity needs when aircraft are routed around bad weather or other blockages.

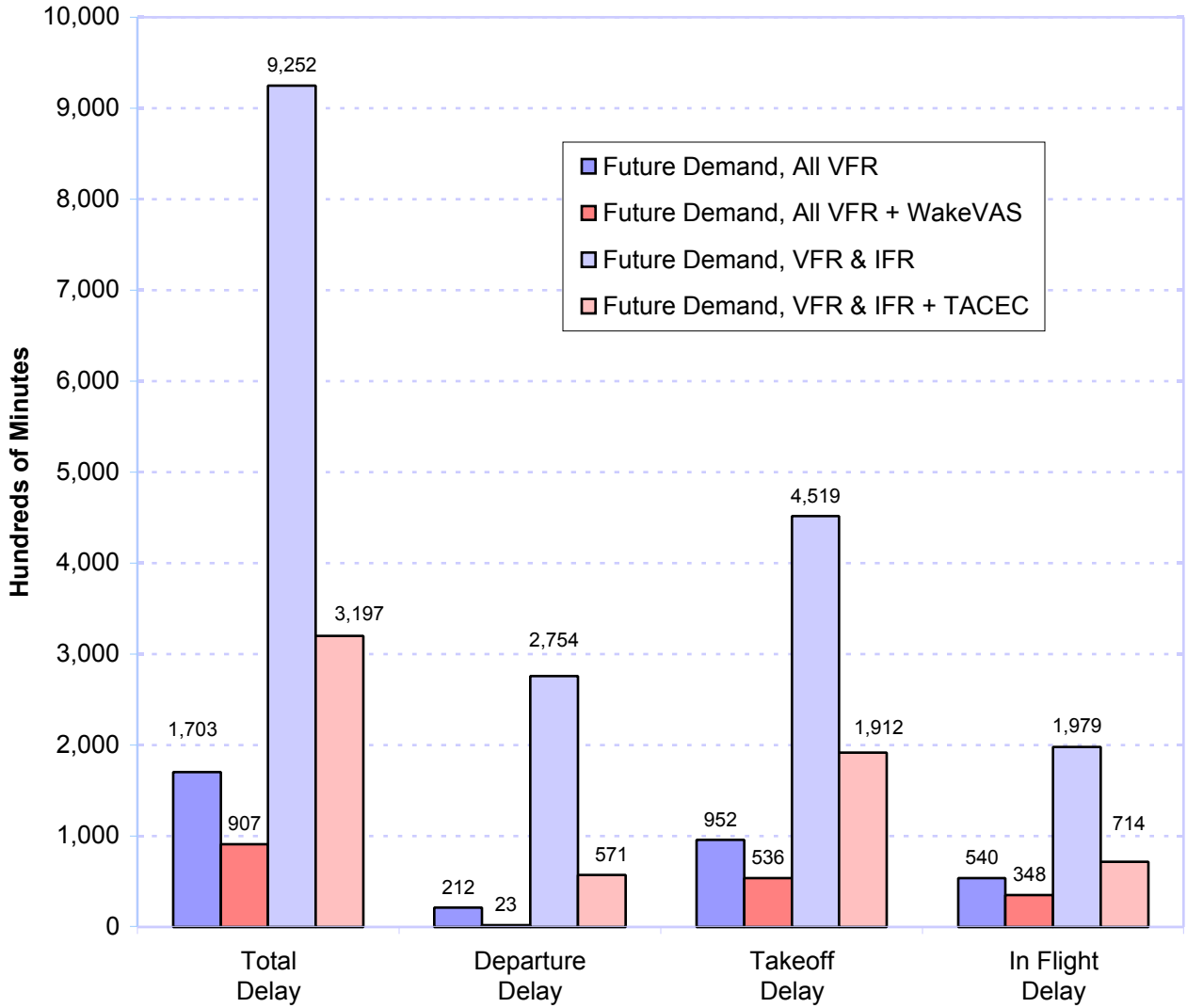
System-Wide Metrics: Current and Future Demand



Delay Metrics: Current Demand, All VFR and VFR & IFR



Delay Metrics: Future Demand, All VFR and VFR & IFR, w/wo WakeVAS & TACEC



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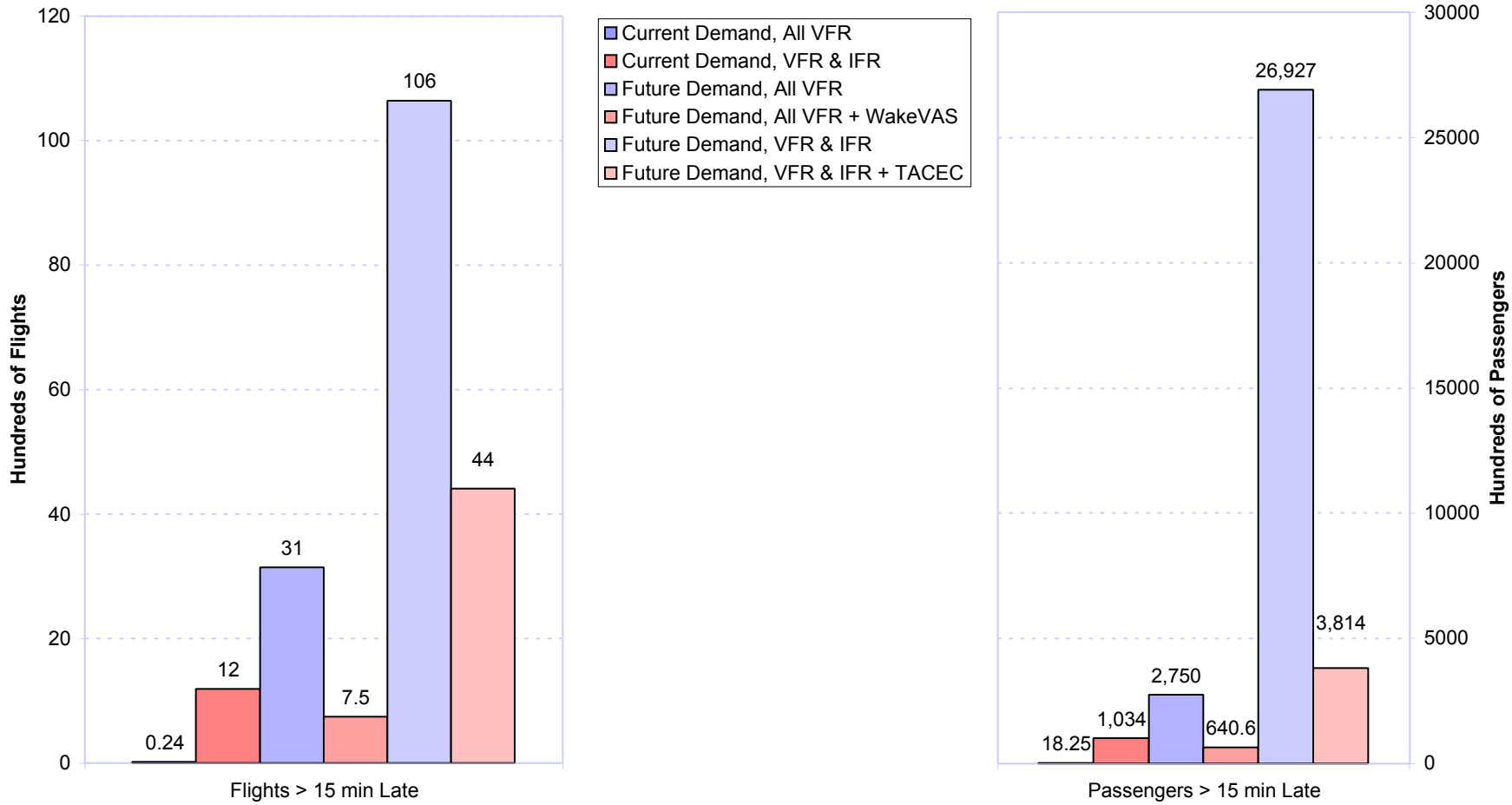
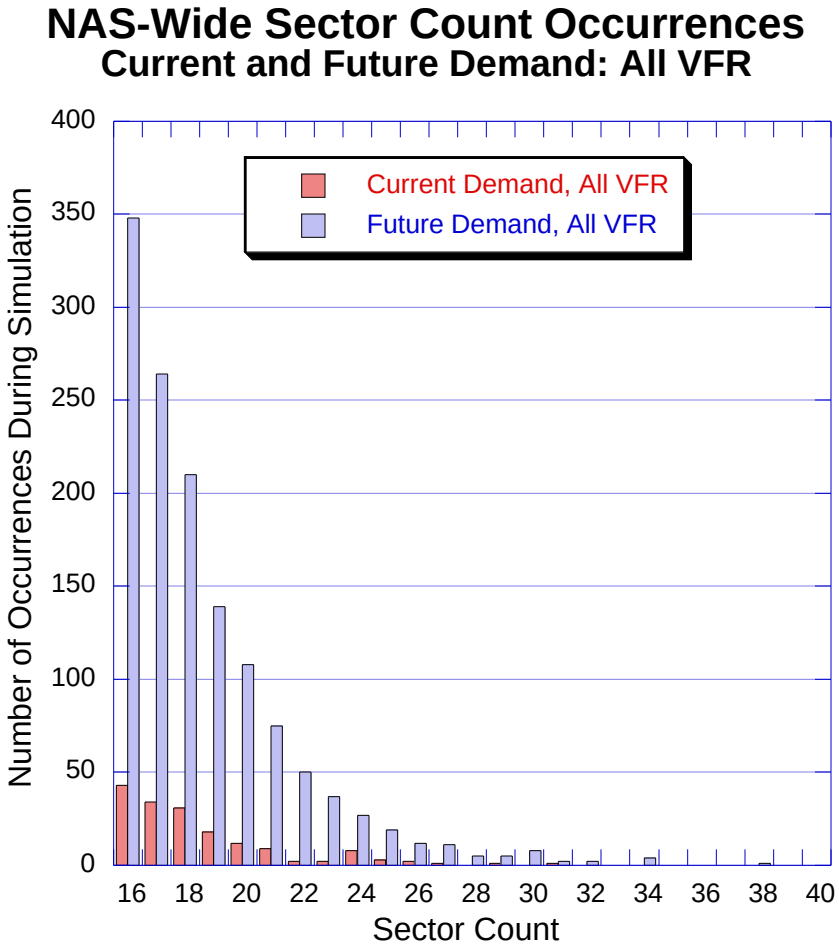
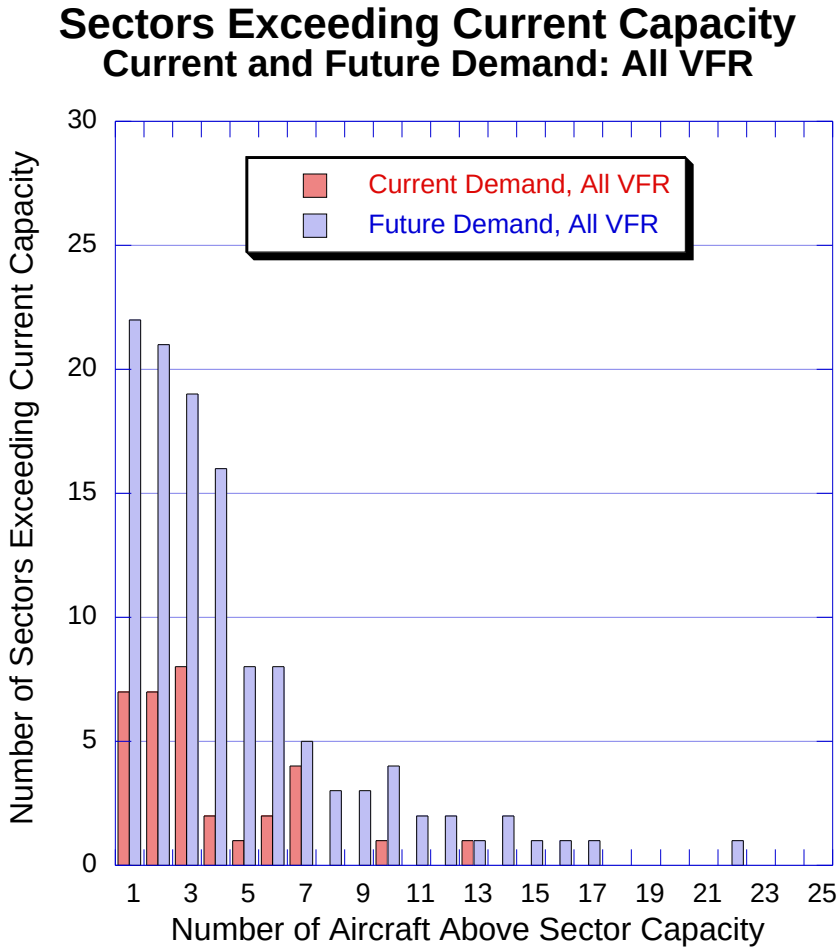


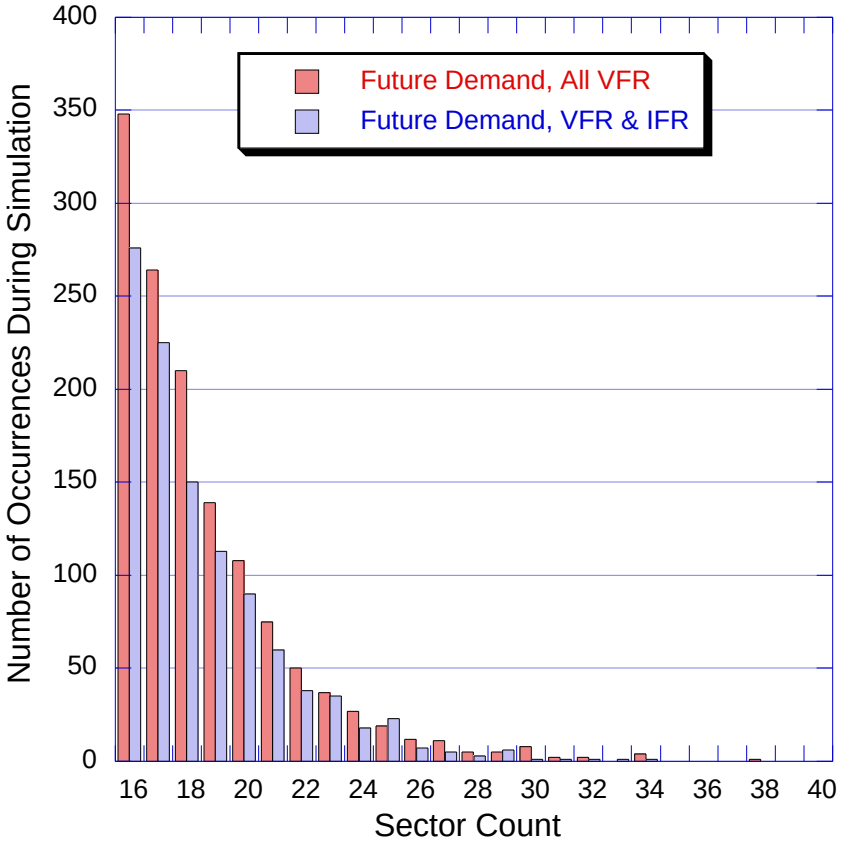
Sector Capacity, Effect of AAC:
Current and Future Demand, All VFR



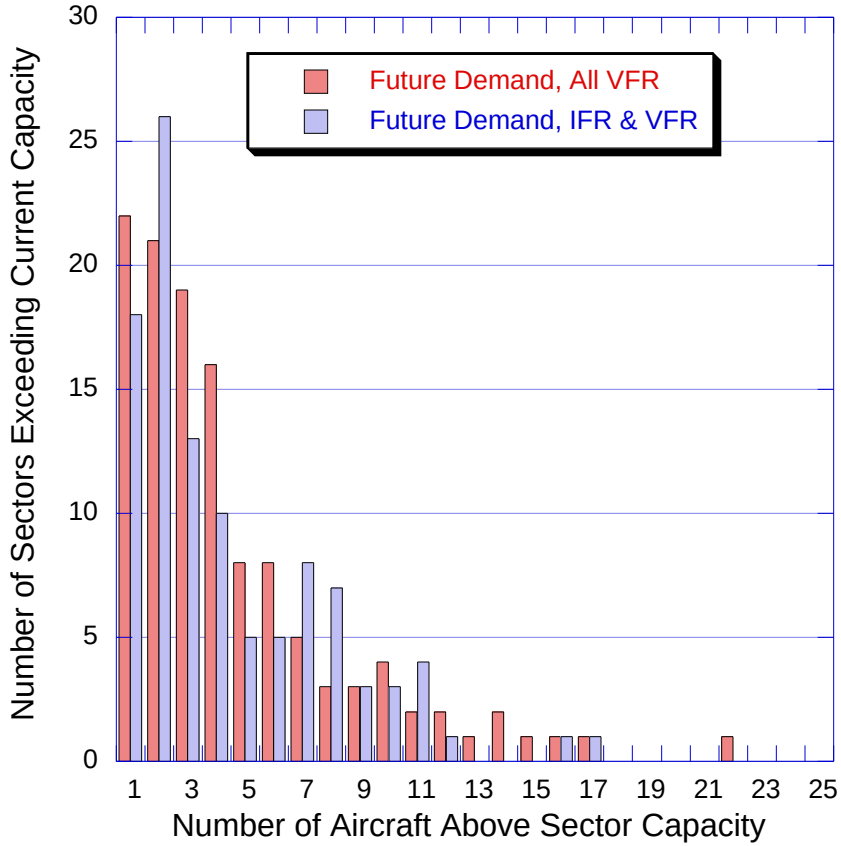


Sector Capacity, Effect of AAC:
Future Demand, All VFR and VFR & IFR

NAS-Wide Sector Count Occurrences
Future Demand: All VFR and VFR & IFR



Sectors Exceeding Current Capacity
Future Demand: All VFR and VFR & IFR



Assessment Findings

OEP proposed runway construction and technology improvements alone will not provide the necessary capacity for a doubled future demand

Additional capacity provided by the assessed VAMS concepts is beneficial in reducing future delay by up to 65%

Further concept integration is necessary for optimal system capacity

Additional concepts will be required to reduce future delays to at or below current-day levels

Summary

- The first ACES system-wide future NAS concept assessment
  - Delay increases are significant for future traffic demands
  - Assessed concepts reduce anticipated delays by up to 65%
- Continued development of VAMS concepts is necessary
  - AAC is shown to be a critical enabling concept for achieving higher airport throughput for all future scenarios
  - TACEC and WakeVAS were both shown to significantly reduce system-wide delays
  - Further concept integration is necessary for optimal system capacity
  - Additional concepts will be required to reduce future delays to at or below current-day levels
- Future Activities
  - Analysts will continue examining the data this study produced, gaining further insight into the modeled NAS concepts and extendable uses of ACES
  - ACES capabilities will be further enhanced and refined for improved concept assessments including enhancement of en-route, terminal and surface models, and architecture and usability